Name = Abubakar

ID = 3795

Section = A

Paper = Highway and Traffic Engg

ID = 3375 Page (1)

QNO 1:- Part (a)

Difference btw flexible and rigid Pavements:-

Flexible Pavements:-

⇒ Bitumen is used as a binder in flexible Pavement.

⇒ Have low flexural strength and consist of series of layer.

⇒ NO thermal stresses are induced.

⇒ Surface can not be laid directly on subgrade.

⇒ Have low life span usually 10-15 years.

⇒ low initial cost and high maintenance cost

⇒ Damaged by oils and certain chemicals.

⇒ Flexible pavement are workable after 24 hours of construction.

Rigid Pavements:-

⇒ Cement is used as a binder in rigid pavement.

⇒ Have more flexural strength and consist of one layer portland concrete slab.

⇒ Surfacing can be laid directly on the subgrade.

⇒ Thermal stresses are induced.

⇒ Have more life span than flexible pavement.

⇒ High initial cost and low maintenance cost.

⇒ It can not be used untill 14 days of curing.

ID 3795 Page (3)
QNO 1 part (B)

ANS:-

Advantage of water bound over wet mix macadam:-

⇒ The construction cost of water bound macadam road is comparatively low.

⇒ Water bound macadum is superior in quality because the material are carefully graded and resulting mass is almost void less compacted mass.

⇒ In the construction of WBM road noskilled labours are required.

⇒ If the WBM roads are maintained properly and from time to time it can resist load of traffic of about 900 tonnes per lane per day.

⇒ The interlocking of aggregate peoticles imparts adequate strength of the materiel selected for filling the voids. These ensure non-entry of the Plastic meterial of the surface into the voids.

In (B.T.S) page (3)
Q No 1 Part (c)

Ans:-
Difference between Asphalt and bitumen:-
Asphalt :-
⇒ Asphalt is produced in a plant that heats, dries and mixes aggregate, bitumen and sand into a composite mix.
⇒ It is a composite mixture that provides a durable and flexible surface for cars and heavy vehicles.
⇒ Asphalt is generally used as a term to refer to the combination of bitumen and gravel specifically for road construction.

Bitumen:-
⇒ Bitumen is a binding agent produced from petroleum. Bitumen is known for being strongly adhesive and resistant to damage from water and oil spills.
Bitumen is actually the liquid binder that holds asphalt together.
⇒ Bitumen is only used by commercial supplies as a binder or sealant for other products.

QNO 2:-
Numericals-

Sol:-
As for a design speed of 75 min/h

K = 312

Minimum length = $312 \times [3-(-4)] = 2184 ft$

Station of BVC = $(345+60) - \left(\frac{21+84}{2}\right)$

= 334+68

Station of EVC = (334+68) + (21+84)

= 356+52

Elevation of BVC = $250 - \left(0.03 \times \frac{2184}{2}\right)$

= 217.24 ft

Station	Distance from BVC (x) (ft)	Tangent Elevation	Offset $y = \left[\frac{Ax^2}{200L}\right]$ ft	Curve elevation elevation offset.
BVC 334+68	0	217.24	0.01	217.24
BVC 335+00	32	$217.24 + \frac{32}{100} \times 3 = 218.20$	0.02	218.18
BVC 336+00	132	221.20	0.28	220.93
BVC 337+00	232	224.20	0.86	223.34
BVC 338+00	332	227.20	1.77	225.42
BVC 339+00	432	230.20	2.99	227.21
BVC 340+00	532	233.20	4.54	228.66
BVC 341+00	632	236.20	6.40	229.80
BVC+342+00	732	239.20	8.59	230.61
BVC+343+00	832	242.20	11.09	231.28
BVC+344+00	932	245.20	13.93	231.28
BVC 345+00	1032	248.20	17.07	231.28
BVC 346+00	1132	251.20	20.54	230.66
BVC 347+00	1232	254.20	24.32	229.88

Station	Distance from BVC (x) ft	tangent elevation	Offset $y=\left(\frac{nx^2}{200L}\right)ft$	Elevation tangent
BVC 348+00	1332	257.20	28.43	228.77
BVC 349+00	1432	260.20	32.86	227.34
BVC 350+00	1532	263.20	37.51	225.69
BVC 351+00	1632	266.20	42.38	223.82
BVC 352+00	1732	269.20	48.07	221.13
BVC 353+00	1832	272.20	53.79	218.41
BVC+354+00	1932	275.20	59.82	215.38
BVC 355+00	2032	278.20	66.17	212.03
BVC 356+00	2132	281.20	72.84	208.36
BVC 356+59	2184	282.76	76.44	206.32

Q NO 3:-

Numerical:-

Given:-

⇒ Reliability level (R) = 99%

⇒ standard deviation (So) = 0.49

⇒ initial serviceability index pi = 4.5

⇒ Terminal serviceability index pt = 2.5

⇒ ΔPSI = 4.5 - 2.5 = 2.0

Req:-

⇒ SN_1 and D_1 (surface course)

Sol:- As

step 1:-

⇒ Draw the line joining the reliability level of 99% and the overall standard deviation So of 0.49.

step # 2:-

⇒ Draw a line joining point A to the ESAL of 2×10^6.

step # 3:-

⇒ Draw a line joing point B and resilient modulus (Mr) of base course and extend this line. to intersect the design serviceability loss chart at point C.

step #4:-

Draw a horizontal line from the point C to intersect the design serviceability.

↳ loss (PSI) curve at point D

$\Delta PSI = 4.5 - 2.5 = 2$

↳ D1 of surface course is 2.0.

step #5:-

⇒ So the structure number required to protect the base course and to find the thickness D1 of the surface course is 2.0.

step #6:-

Determine the appropriate structure layer coefficient for each construction material. Resilient value of asphalt

= 45,000 lb/in².

Therefore a1 = 0.44

Thickness of surface course D1:-

$D1 = SN1 / a1$

$2.6 / 0.44 = 5.9$

Thickness should be taken to the

nearest 0.5 inches

So the thickness of the surface course is 6".

Base (2)

$\Rightarrow SN_1^* = D1 \times 91$

$\Rightarrow SN1 = 6 \times 0.44 = 2.64.$

Finding SN2 and D2 Base course

$D2 = (SN2 - SN1^* / 92\ m2$

$= (3.8 - 2.04) / 0.14 \times 0.80$

$D2 = 10.36''$

use $12''$

so thickness of base course is $12''$

$SN_2^* = 0.14 \times 0.80 \times 12 + SN1^*$

$SN_2^* = 1.34 + 2.64$

$SN_2^* = 3.98.$

Finding SN3 and D3 (sub base course).

$$D3 = (SN3 - SN2^{*}) / 93\ m3$$

$$= (4.4 - 3.98) / 0.10 \times 0.80$$

$$D3 = 5.25''$$

Ixie will use "6" as sub base

$$SN3 = 2.64 + 1.34 + 6'' \times 0.10 \times 0.80$$

$$SN3 = 4.46 > 4.4 \quad OKay$$

Final design

⇒ Surface course = 6"

⇒ Base course = 12"

⇒ Sub base = 6"

⇒ Total pavement thickness = 24".

ID = 7795 Page (22)

Q No 4:- Explain different pavement distresses?

Ans:-

Pavement distresses:-

→ Distress is a condition of the pavement structure that reduces serviceability or leads to a reduction in service life.

→ Distresses could occurs in a pavement due to

→ Unstable mixes

→ Higher wheel loads than those considered in design.

Different Pavement distresses:-

Alligator cracking:-

→ Known as map cracking or fatigue failure since it appears similar as alligator skin so it is called as alligator cracking.

→ The failure can be due to weakness in surface base or subgrade, a surface that is too thin, poor drainage or the combination of all three.

→ The main reason of this type of failure is the repetitive application of heavy movement of traffic.

ID = 7775 Page (12)

Block cracking:-

⇒ Block cracking look like large interconnected rectangles (roughly).

⇒ Generally it is caused by shrinkage of the asphalt pavement due to an inability of asphalt binder to expand and contract with temperature cycles.

⇒ This can be because the mix was mixed and placed too dry.

⇒ It spread over a large area of ground.

Longitudinal cracking:-

⇒ Longitudinal cracks are individual and run parallel to the centerline.

⇒ This distress can be considered as either a structural or an environmental distress.

⇒ These can be a result of both pavement fatigue reflective cracking, or poor joint construction.

Rutting:-

⇒ Surface depression in the wheel path, are particularly evident after a rain when they are filled with water.

Possible causes-

⇒ Insufficient compaction of HMA layers during construction.

⇒ Subgrade rutting (i.e.s as a result of inadequate pavement structure.

ID= 7795 Page (13)

Repair-

⇒ slight ruts (< 1/3 inch deep) can generally be left untreated. Pavement with deeper ruts should be leveled and overlayed.

⇒ **Bleeding**

⇒ **problem:-**

⇒ loss of skid resistance when wet.

possible cause:-

⇒ Excessive asphalt binder in the HMA

⇒ Low HMA air void content.

⇒ Excessive application of asphalt binder during BST application.

Polished aggregate

Possible cause-

⇒ Repeated traffic application. This can occur quicker if the aggregate is susceptible to abrasion.

Repair-

⇒ Apply a skid-resistant slurry seal, BST or non-structural overlay.

Raveling:-

loose debris on the pavement which increase pave roughness and loss of skid resistance.

possible cause-

⇒ Asphalt binder ages.

⇒ Inadequate compaction during construction.

Repair- Fog seal / slurry seal or remove the damaged pavement and overlay.